ing a chamber to equilibrate with atmospheric pressure, ports for introducing air bubbles or slugs into a fluid stream and/or as fluidic connections to a cartridge reader. FIG. **9** also depicts a number of fluidic conduits (shown as lines connecting the various chambers) that establish a fluidic network that connects the various compartments and/or fluid ports/vents. The fluidic conduits may comprise distribution points (e.g., branch points such as distribution point **976** that are adapted to distribute a fluid to two or more locations/compartments in a cartridge). Other fluidic features that are shown in FIG. **9** include pill chambers/zones **990**, **991** for each of the read chambers. FIG. **10** depicts a three dimensional representation of the fluidic network formed by the various fluidic components employed in a preferred embodiment of FIG. **9**.

[0263] Sample chamber **920** is a chamber defined within cartridge **900** that is adapted for receiving a sample, preferably a liquid sample, to be analyzed in the cartridge. Sample chamber **920** includes a sample introduction port **921**, and is linked to vent port **953** through a vent conduit and detection chambers **945** and **946** through sample conduit **901** having sample conduit branches **940** and **941**. Preferably, cartridge **900** also includes a sealable closure for sealing sample introduction port **921**. Reagent chamber **925** is a chamber adapted to hold a liquid reagent and includes a vent conduit linked to vent port **950** and reagent conduit **902** linked to the sample conduit (preferably, between sample chamber **920** and distribution point **976**). Also linked to the sample conduit is air chamber/trap **975** linked to vent port **980**. This arrangement allows for adding/removing air into/from the fluid stream(s) (e.g., to reagent or sample streams directed from reagent chamber **925** or sample chamber **920** towards detection chambers **945** or **946**) in the fluidic pathway by applying positive pressure or suction to vent port **980**. Pill chambers/zones **990** and **991** hold dry reagents and are positioned, respectively, in the fluidic pathway between sample port **920** and detection chambers **945** and **946** so that liquid passing through the chamber/zones will reconstitute the dried reagents and carry the resulting solutions into the detection chambers. Reagent chamber **925**, air chamber trap **975**, vent port **980** and/or pill chamber zones **990** and/or **991** may optionally be omitted.

[0264] Detection chambers **945** and **946** are adapted for carrying out a physical measurement on a sample, preferably an electrochemiluminescence measurement, most preferably a measurement employing an electrode array that is configured to be fired in a pair-wise fashion (as described above). Optionally, detection chamber **946** is omitted. As depicted in the preferred embodiment of FIG. **9**, detection chambers **945** and **946** have different geometrical cross-sections than their respective input and output channels to which they are in fluidic communication. As such, it is preferable to incorporate transitional fluidic segments (**947***a,b* and **948***a,b*) at the inputs and outputs of the read chambers such that fluid flow may be appropriately transitioned between the dissimilar regions. Preferably, the transition is designed to minimize the transition length; e.g., incorporating a diffusers/nozzles with as wide an angle as possible, while being gradual enough to prevent trapping of air bubbles. Detection chambers **945** and **946** are connected via waste conduits **960**,**961** to waste chambers **931** and **930**. Waste chambers **930** and **931** are chambers configured to hold excess or waste fluids and are also connected, respectively, to vent port **952** via a vent conduit and vent port **951** via a vent conduit. The use of multiple waste chambers advantageously allows fluid flow through the multiple chambers to be controlled independently via the application of vacuum or pressure to the waste chamber vent ports. Alternatively, only one waste chamber is used (e.g., waste chamber **930** is omitted and detection chambers **945** and **946** are both connected to waste chamber **931**).

[0265] In cartridges for conducting binding assays for analytes of interest, pill zones **990** and **991** preferably comprise labeled binding reagents (e.g., antibodies, nucleic acids, labeled analogs of analytes of interest, etc.), detection chambers **945** and/or **946** comprise one or more immobilized binding reagents (preferably, an array of immobilized binding reagents, most preferably immobilized on electrodes for conducting ECL assays) and reagent chamber **925** comprises a wash reagent for removing sample solution and/or unbound labeled reagents from the detection chambers. In embodiments where one of the detection chambers is used for control assays or for assay calibration, the associated pill zone may comprise control reagents such as an added analyte (for example, to be used in spike recovery, calibration measurements or control assay measurements).

[0266] The fluidic network of cartridge **900** comprises Z-transitions that may act as capillary breaks and/or allow for the fluidic network to be extended to multiple planes of the cartridge. See, e.g., Z-transitions **1010**-**1014** in FIG. **10**. Z-transition **1011** in the sample conduit and **1013** in the reagent conduit act as capillary breaks which confine sample liquids and reagent liquids to their corresponding chambers. Fluid can be moved from these chambers, in a controlled and reproducible manner, by application of an appropriate pressure gradient. Z-transitions **1060** and **1061** allows the waste conduits to cross sample conduit branches **940** and **941** by arranging them on different layers of the cartridge.

[0267] FIGS. **13***a* and **13***b* show exploded views of one embodiment of cartridge **900** that comprises cartridge body **1100** and cover layers **1324**, **1350**, **1320**, **1321** and **1322** mated to the surfaces of cartridge body **1100**. FIG. **11** shows top (FIG. **11***a*), bottom (FIG. **11***b*) and isometric (FIG. **11***e*) views of cartridge body **1100**. The upper **1101**,**1102** and lower **1103** surfaces of the cartridge body **1100** incorporate (e.g., by molding, machining, etching, etc.) recessed features such as channels, grooves, wells, etc. The features are sealed to provide the chambers and conduits of the cartridge by applying the cover layers to the upper and lower portions of the cartridge body. To allow for adequate sample and/or reagent volumes, the cartridge body has thicker portion **902** which includes features (channels, grooves, wells, compartments, etc.) that define, in part, the sample, reagent and waste chambers. The remainder of the cartridge is, preferably, much thinner so as to minimize cartridge weight, volume and material costs and, in the case, of certain preferred cartridge designs, to allow optical detectors to as close as possible to the top surface of electrodes incorporated on a cover layer on the bottom of a cartridge.

[0268] Reagent chamber **925**, sample chamber **920**, waste chambers **930** and **931** and at least portions of the sample conduit, reagent conduit and waste conduits **960** and **961** are formed by sealing cover **1324** on cartridge body **1100**. Detection chambers **945** and **946** are formed by sealing cover layer **1350** (having patterned conductive layer **1360** (which forms the patterned electrode array **963**, shown in FIG. **9**) and patterned dielectric overlayer **1365**) to cartridge body **1100** through intervening gasket layer **1331** (preferably, made from double sided adhesive tape). The detection chamber's depth, length and width are defined by cutouts **1340** and **1341** within